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THE NASA HOUSE:

A House Constructed and Furnished with Aerospace Technology

JULY 1970

This report was prepared as part of the Urban Development Applications Project which is conducted by Abt Associates Inc. for the Technology Utilization Division at the National Aeronautics and Space Administration.

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PREFACE

This report is the result of a special project to select NASA technology which might be appropriate for housing construction. It was undertaken as part of the Urban Development Applications Project to design and test the feasibility of establishing a center to apply NASA technology to problems in an urban context, and is supported and monitored by NASA Technology Utilization Division, under contract NASW-2022.

The Urban Development Applications Project is directed by Dr. Richard N. Foster. Warren D. Siemens is the Deputy Director and Manager of the Planning Team; Jack Bluestein is manager of the Operations Team. Robert H. Rea, Vice President, is a principal advisor to this project.

Essentially, this report consists of two major sections: I A Walk Through the NASA House; and II Technology Components of a NASA House. The former is a narrative which envisions extensive use of NASA technology in the building of a house. It will be apparent that all of the suggestions made in the narrative are not ready for rapid transfer to the construction industry; rather the "Walk" is intended to represent a picture of some of the possibilities which exist, and contains many ideas which might be further built upon.

The section on technology components is the NASA product listing from which the "Walk" was constructed. It also is intended to be the start of a product catalogue which the UDAP team members intend to refine, add to, and, naturally, use in its technology transfer activities.

This introduction would not be complete without acknowledging the thoughtful assistance received from the following Technology Utilization Offices:

Ames Research Center
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Lewis Research Center
Manned Space Flight Center
Marshall Space Flight Center
Wollops Station

I. A WALK THROUGH A NASA HOUSE

Welcome to the All-NASA House. We have invited you here today to present you with some examples of the non-space benefits of space research and development which we have utilized in this home built with NASA developments. This house does not represent any house that is on the market today, but it does represent one that could be produced attractively if sufficient volume were assured. You may be aware of the fact that we currently estimate a growing deficit of 1,100,000 housing units per year in the United States. Only a moderate percentage of these units would be needed to justify a factory which could economically produce a large number of the components you will see today.

We shall begin by exploring the outside of the house. While you observe it as a total unit, let me take the opportunity to tell you a bit more about its construction.

This house was designed by a local architectural firm and uses a conventional wood frame. The structure, however, is quite different from traditional structures. Due to the rapidly diminishing supply and rising cost of wood, efficiency in structural materials has become increasingly necessary. Through the use of a structural analysis computer program (B68-10096), the architects and engineers were able to reduce significantly the amount of structural wood used in the house. When the basic framework design was completed, all the data on the house was fed to a NASA computer program (B68-10128) which produced drawings of the house and allowed changes in the final specifications to be made quickly and with little effort. This program also drafted the blueprints, thereby eliminating large drafting costs. The cost of the building was further reduced through the use of NASA-developed program performance aids (B67-10568).

Before construction, the wood for the frame was coated with special intumescent paints for fire protection (Ames.) These paints expand when exposed to high temperatures to form an insulating layer which protects the wood beneath from burning. While they expand, they also give off gases which help extinguish the fire. The pre-treated

wood frames were then quickly assembled into the basic structure of the house by using an automatically expandable-collapsible truss structure (B65-10126). To efficiently utilize construction time, the conventional method of nailing the house frame together was eliminated. Instead, adhesives were used (B66-10185, B67-10013, B67-10227), which are in fact stronger than nails. In some instances screws had to be used, in which case self-locking devices were used on the screws (B65-10135).

While the building was proceeding the ground work was being carried out simultaneously. A hoisting frame (B68-10575) was put to use to remove such obstacles as large rocks and tree stumps from the grounds. An inflatable bladder (B69-10069) was also used to facilitate the removal of these objects and eliminate the use of explosives. Buckles (B64-10119) joined web straps quickly when the load was being removed with the hoist. The crane itself was proof-loaded with calibrated water tank facilities (B69-10109).

As we continue around to the back of the house, I would like to point out the latch in the back door; it is called a Boydbolt latch (B68-10512). This lock positively prevents accidental locking or unlocking of the door. Although it may not be readily noticeable, the doors and external walls are made from either fiberglass-reinforced structural materials or aluminum. These walls are covered with a variety of durable fireproof paints (B69-10098, B65-10156, B66-10027). Much of the information used in selecting these materials was provided by NASA (B68-10360, B67-10089).

May I ask you to note the reflective surface near the corner of the house. This surface is actually a variable transparency wall (B63-10528) which can be used to regulate the temperature of the house. Although it is most effective on sunny days, it aids in maintaining low heating and air conditioning bills. In addition, the southern exposure has been covered with a temperature-controlling paint which serves to keep down the costs of heating and cooling. All these surfaces have been tested for durability in a simulated hailstorm device (B68-10552).

In conjunction with the heating and cooling aids previously mentioned, NASA has done a substantial amount of work on thermal insula-

tion systems (NASA SP-5027). The insulation on this house is a one-inch thick sprayed polyurethane foam (B68-10358). This material does not pack with age as does fiberglass or mineral insulation, can be applied easily, and can cut thermal losses by as much as 50%. Not only does this reduce your heating bill, but it also helps to control air pollution caused by contaminants escaping from the furnace. A borax/polyester system is employed (B67-10016) to give the structure greater fire retardency. The plumbing and electrical lines are in the walls; they are much more accessible here due to the thinness of the insulation layer. You will see more of these improvements when we go down to the basement.

Before we proceed to the basement, however, let me point out that the foundation of the house is made of post-stressed concrete, (B67-10237). Post-stressing closes any cracks left in the concrete. This not only helps to keep the basement dry, but also acts as a buff between the house and vibrations of trucks or even minor local earthquakes. A rubberlike thermoplastic material (B66-10453) which covers the outside of the foundation, further protects the house by insuring a waterfree basement.

Not only building materials, but also a large number of the tools used to fabricate the structure were the result of aerospace efforts. Some examples are a portable sandblaster (B66-10242), a soldering iron used to cut synthetic materials rapidly (B66-10246), a hand drill adapter for limiting the depth of a bored hole (B66-10123), a gun to facilitate adhesive bonding of studs to surfaces (B69-10009), a torque wrench (B66-10011), a miniature paint-spraying gun (B68-10387), and a modified spray gun to prevent adhesives from hardening in the gun (B63-10318).

After the structure was finished, many quality tests were performed. Liquid crystals were used to detect voids in the fiberglass portions of the walls (B67-10286); polarized light revealed stresses in laminated plastics (B67-10383); microwaves detected surface cracks in the foundation (B67-10482); mechanized ultrasonic scanning systems (B68-10004) with improved camera tubes (B68-10088) were employed to measure residual stress (B67-10428); to test adhesive bonds in the main frame, ultrasonics were used (B66-10341). The thermal

conductivity of the walls was tested also (B68-10013). All this quality testing was guided by handbooks for non-destructive testing (B69-10108).

As we proceed to the front of the house and walk in the front door, we see the living room off to the left. The walls are made of load-bearing bonded-honeycomb sandwich panels (B67-10427). These panels offer the advantage of flexibility (some of the walls are mobile) and time-saving during construction, since utilities can be carried in the outer walls, thus eliminating the need to construct an inner framework. The bookshelves are attached directly to the walls with a fastener (B65-10358) which distributes stress evenly. The honeycomb sandwich panels are very stable; they have been "rigidized" with para-dichlorobenzene (XMF-07725) which also permits them to be machined. This allows the creation of the molded effects you see at the edges. It could also permit walls of unusual shapes to be made if you so desired. I should point out that the non-load bearing walls are aluminum and quite light. Their honeycomb structure was brazed to the wall without the use of a flux (B66-10360), making the structure more durable and also eliminating a step in the manufacturing process.

Of course, these structures have all been tested for integrity (B66-10544, B67-10574) and entrapped moisture (B67-10116), which can cause buckling of the panels under unfavorable conditions.

Proceeding into the kitchen, we will point out only those items that are of special interest. First of all, the kitchen has been fire-proofed. It has been analyzed with the use of a combustion hazard model (B69-10287) to design out as many hazards as possible. Those fire hazards that could not be eliminated altogether were made of fireproof materials such as the intumescent paints discussed before. Were any grease of electrical fires to occur, high expansion foams (N69-20776) can be used to put them out. A secondary fast-acting, pneumatically controlled fire extinguished system (Firex) has also been installed (B67-10622).

In the NASA House the kitchen is also the center of the home communication system. This miniaturized system (B67-10119) includes a television monitor (B67-10162) for small TV cameras located throughout the house (B67-10469). Light panels (B66-10507, B63-

10435) illuminate important control areas for both this communication center and the kitchen utility areas. In those cabinets to your left is the refrigerator which, as you can see, is unusually thin. Aluminized fiberglass insulation (B66-10024) makes this possible. Since this type of insulation can conform to curved surfaces, the shape of the refrigerator is not limited. The oven has the same advantages; it is made of a foamed refractory oxide material (B66-10288).

Going upstairs we see the bedrooms, which are heated, as are all the other rooms, by quite small yet highly-efficient radiators. Optimal efficiency has been achieved in their design through a NASA computer program (B66-10618). Temperature is controlled at several points in the room by a small, barely visible thin film thermal detector in the wall (B67-10505). Much of the furniture in the room is fireproof plastic. As you can see, it is almost indistinguishable from wood furniture. This effect is accomplished by using foamed plastics and special molding processes (B68-10132). In the bathroom we see a conventional tub and sink; what we can't see is that they are not made of real porcelain but of special ceramic coatings tested and evaluated by NASA (B68-10355).

You have probably all been wondering about the heating and electricity. They are controlled from the basement. Let us go down and see that part of the house now.

The basement is the working area of the house. On the right is the multichannel wireway adapter box (B68-10052), which functions to provide continuous separation of different electrical leads at points where their runs must intersect. This is helpful for prevention of crossed wire leads carrying different currents. As you can see, the wires themselves are not round, as in the conventional house, but flat and quite thin. Flat conductor cable (MSFC) is not only quick to install and inexpensive, but also eliminates the raceways normally created with the use of round cable. The connectors used with flat conductor cable have made use of design concepts for non-arcing electrical connectors (B68-10404). They are moisture-proof and corrosion-proof (B65-10196) and are also inexpensive (B63-10568). A single connector can provide safety fuses for multiple lines (B66-10050). The fuses are solid state recoverable fuses that really act as circuit breakers (B66-10691).

In front of you is the heating system. The gas-fired furnace is made of a refractory ceramic (B63-10481) which is quite strong and did not require firing in the manufacturing process. It is covered with a foamed ceramic body that also has good thermal insulating qualities up to 3000°F (B67-10441). This superior insulation is demonstrated by the small size of the unit. If electric heat is preferred to gas, however, a heater control circuit can provide both fast and proportional control (B67-10097). The central heating system in either case was designed with a NASA computer program (B66-10404).

Another feature of this house is the air sample which counts, categorizes, and records particle data (B67-10076). This data can then be used to minimize the amounts of pollutants generated in the furnace.

Off to the left is part of the plumbing system. This system was designed with a NASA computer program (B68-10395) to minimize pressure loss. The valves in the system have elastic seats to ensure positive closure (B65-10040). Pipe joints are reinforced in place with fitted aluminum sleeves (B67-10271). Inexpensive metal tube reducers (B67-10401) are used throughout the house and heat-shrunk plastic tubing seals joined to glass tubing (B68-10040) in special heavy duty areas. The system is outfitted with hand tightened pressure seals (B68-10417). Welding has been done with an aluminum oxide filler (B66-10125) to prevent obstructions. A NASA-developed burnishing technique aided in the lubrication of threaded fasteners (B65-10302). Aluminum pipes have been used in a few areas. These pipes were fastened together by a brazing process (B66-10241). Tubing joints are reinforced with a split aluminum shield (B68-10115). If a pipe should ever leak, although that is highly unlikely, it can be repaired with a small joint leak repair coupling (B68-10115).

The heating, plumbing, and electrical systems have, of course, been thoroughly tested. An electrical probe (B65-10215) was used to ensure reliable contacts in the electric system and ultrasonic hand tools allowed convenient scanning of the spot welds (B66-10289, B66-10220). In some critical cases an automatic, non-destructive, in-process test of the welds was conducted (B68-10333). These are just

a few examples of the testing methods drawn for use on the NASA House from an evaluation of many approaches to non-destructive testing (B68-10191).

A number of the tools used were of NASA design. Tools (SP-5924[01]) and apparatus (B68-10429) for preparing flat conductor cable connections were routinely used. A wire puller (B65-10031) facilitated bringing leads in from the outside and a coaxial cable stripper (B68-10444) speeded up the electrical installation. A new tool (B66-10115) which heats and applies solder in one application cut soldering time, and welding was improved by both a weld preparation tool (B68-10551) and an improved torch (B68-10041). A tube-swaging device (B68-10235) provided strong, lead-proof assembly. A pipe-cutting tool was found to be especially useful in tight spaces (B66-10102). A bench vise adapter (B66-10056) secured thin-wall tubing during cutting and flaring without marring or damaging the tube. A two-axis winch (B69-10062) was used to install some of the heavier ducts. Thus, NASA's contributions to the heating, plumbing, and electrical systems, as you can see, are quite substantial.

Leaving the basement and going out through the garage, we can see that the car washing is done here. The hose is on a drum (B65-10185) which eliminates torsion and minimizes strain on the hose, giving it longer life. The garage door is lifted by a small extendible-retractable boom (B63-10200). The new life-raft (B64-10001) in the corner would be ideal to take along when you go on vacation. It's non-tippable and a duplicate of the ones the astronauts use during splash-down. If you're not going on a vacation you can use it as a backyard swimming pool for the kids.

Well, that's the end of the tour. We hope you have found it interesting. No doubt in five years much of what you've seen today will look familiar to you, since your own houses will be using more and more of this new technology all the time. When you return here however, the NASA House is likely to have changed a great deal as improvements are constantly being made with new products developed as a result of advances in space research and development.

II. TECHNOLOGY COMPONENTS OF A NASA HOUSE

1. INTRODUCTION TO NASA TECHNOLOGY LISTINGS

On the pages which follow NASA technology is listed which either (1) already has demonstrated its potential for housing applications or (2) represents concepts which might be transferable to housing. The four classifications of housing which have been used to separate the technologies were chosen in the following manner:

1. Basic housing components - refers to physical products which can be seen or touched, become part of the finished structure and are not considered as luxuries or frills to the basic house.

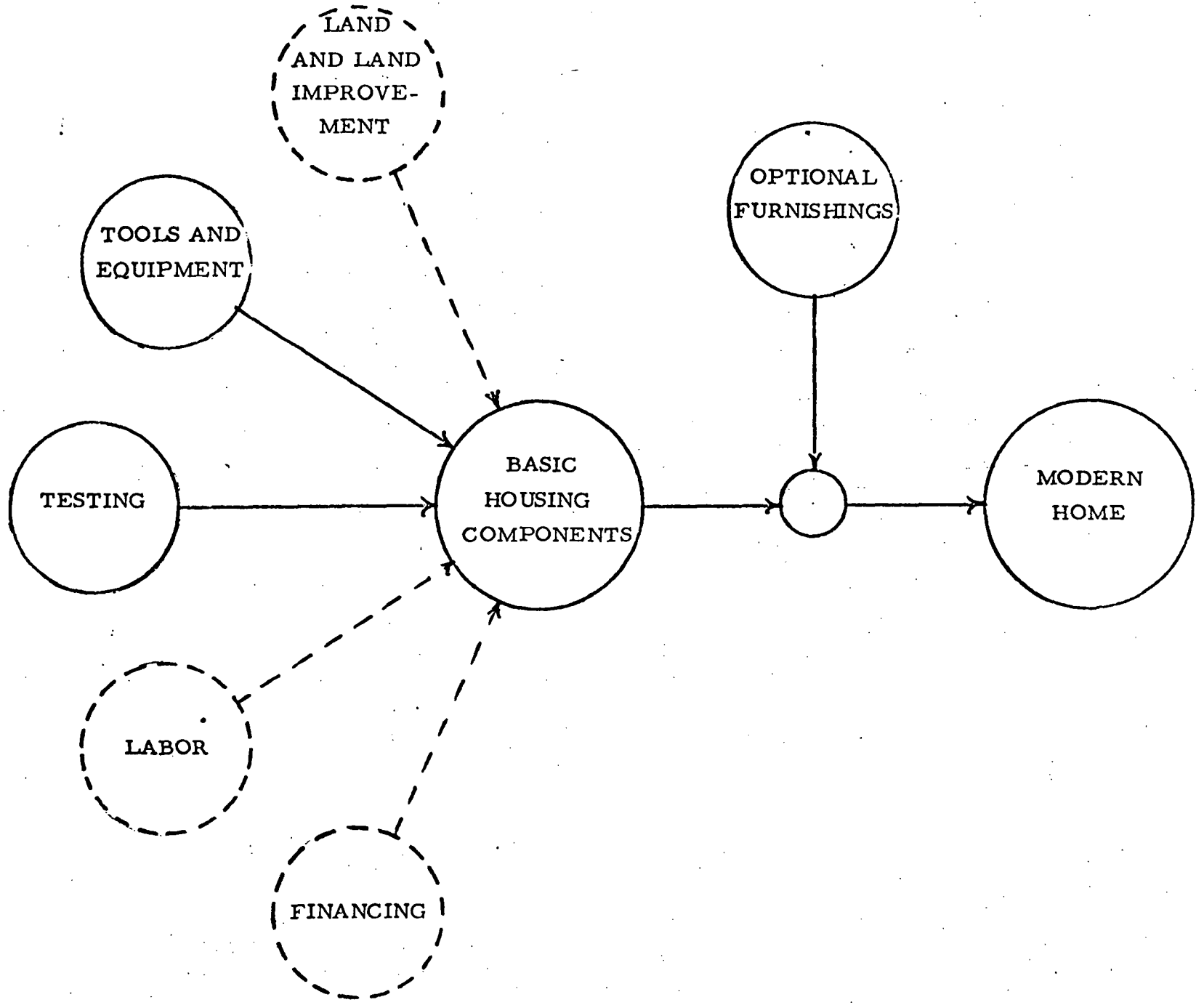
2. Tools and equipment - refers to those items which are supportive and necessary to preparation and assembly of the housing system, but do not become part of the structure itself.

3. Testing - NASA testing facilities and techniques which may be incorporated into the process of manufacturing or quality control of products later used in construction.

4. Optional furnishings - these consist of technologies applicable to home furnishings and other more luxurious items.

Within each of the four classifications a short description of the NASA technology is listed alphabetically by product category. A cover sheet to each section displays the alphabetical listing as well as the number of specific product listings the reader should expect to encounter under each.

TECHNOLOGY COMPONENTS OF A MODERN HOME



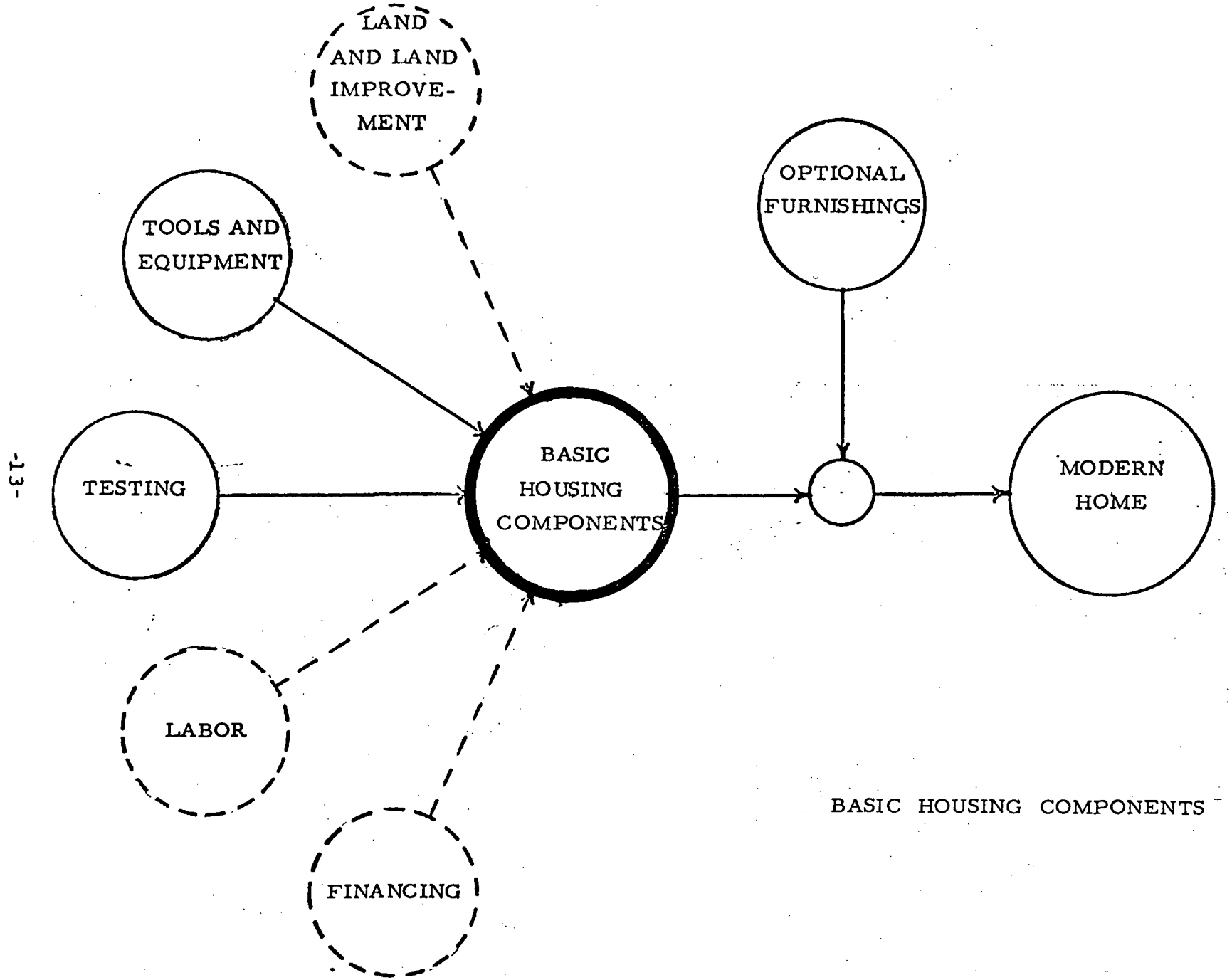
TECHNOLOGY CLASSIFICATIONS

Number of Products Discussed

	Basic Housing Components	Tools Equipment	Testing	Optional Furnishings	TOTAL
Adhesives	9	7	2		18
Coatings/Finishes	6	2	1	9	18
Electrical:					
Communications					
Lighting					
Power	7	7		3	17
Fire & Security Control	3		1	1	5
Foundation Material	2			1	3
Heating/Cooling	4	1	2		7
Insulation	9		1	2	12
Plumbing	5	12	4		21
Structural Material	8	4	7		19
Surface Material	6	6	2		14
General Category		8	4	17	29
TOTAL	59	47	24	33	163

2. BASIC HOUSING COMPONENTS

TECHNOLOGY COMPONENTS OF A MODERN HOME



BASIC HOUSING COMPONENTS

BASIC HOUSING COMPONENTS

	Number of Products Discussed
Adhesives/Fasteners	9
Coatings /Finishes	6
Electrical:	
Communications	
Lighting	
Power	7
Fire & Security Control	3
Foundation Material	2
Heating/Cooling	4
Insulation	9
Plumbing	5
Structural Material	8
Surface Material	6
General Category	
TOTAL	58

BASIC HOUSING COMPONENTS

ADHESIVES/FASTENERS

1. Photosensitive Filler Minimizes Internal Stresses in Epoxy Resins

   Method produces an epoxy resin which has high resistance to thermal shock and conditioning.

   Contractor: IBM for MFSC (MFS-1880) B67-10227

2. Nonwoven Glass Fiber Reinforces Polyurethane Adhesive

   Glass fiber mat ensures good control of the bond line and imparts increased peel strength to the adhesive.

   Contractor: Douglas Aircraft Company for MSFC (M-FS-2309) B67-10113

3. Improved Adhesive for Cryogenic Applications Cures at Room Temperature

   The interesting feature here is the fact that the adhesive cures at room temperature and does not require heating. The effects of higher than room temperatures on the peel strength may be a deterrent to use in construction.

   Contractor: Telecomputing Corp. for Western Operations Office (WOO-132) B66-10185

4. Burnishing Technique Improves Lubrication of Threaded Fasteners

   Molydisulfide coating is applied to fastener threads and improves lubrication.

   Contractor: Lockheed for Lewis (Lewis R. C. -217) B65-10302

5. Aluminum Core Structures Brazed Without Use of Flux

   Aluminum alloy face sheets are brazed aluminum alloy honeycomb cores without using corrosive flux by means of one of three methods. The completed brazed structure has the high-strength characteristics of heat-treated aluminum alloys.

   Contractor: Aeronica Manufacturing Corp. (M-FS-659) B66-10360

6. Elastomers Bonded to Metal Surfaces Seal Electrochemical Cells

A leakproof seal secondary cell containing alkaline electrolytes was developed by bonding an alkali-resistant elastomer, such as neoprene, to metal contact surfaces. Test results of several different elastomers strongly indicate the feasibility of this sealing method.

Contractor: J. M. Sherfey for GSFC (GFSC-168) B64-10113

7. Brazing Process Using Al-Si Filler Alloy Reliably Bonds Aluminum Parts

Brazing process employs an aluminum-silicon filler alloy for diffusion bonding of aluminum parts in a vacuum or inert gas atmosphere. This process is carried out at temperatures substantially below those required in conventional process and produces bonds of greater strength and reliability.

Contractor: North American Aviation for MSC (MSC-448) B66-10241

8. Fastener Distributes Stress Evenly From Sandwich-Panel-Hung Items

Items are attached externally to cellular-core sandwich panels by a fastener anchored in the panel by a constant amount of adhesive. The changes caused to the core cells and skin sheets are minimized.

Contractor: North American Aviation for MSC (MSC-236) B65-10358

9. Boydbolt, A Positive-Latch, Simple-Release Fastener

Fastener/Boydbolt/ has recently been designed to furnish positive lock and release characteristics that positively prevent accidental adverse functions of lock or release.

Contractor: Bendix Corporation for MSC (MSC-13061) B68-10512

COATINGS AND FINISHES

1. **Corrosion Protection of Aluminum Alloys in Contact With Other Metals**

   Study establishes the quality of chemical and galvanized protection afforded by anodized and aldozided coatings applied to test panels of various aluminum alloys. The test panels, placed in firm contact with panels of titanium alloys, were subjected to salt spray tests and visually examined for corrosion effect.

   Contractor: North American Rockwell Corporation for MSFC (M-FS-18526) B69-10098

2. **Inorganic Paint is Durable, Fireproof, Easy to Apply**

   Inorganic paint with a water-potassium silicate base is impervious to water. It is also fireproof and adheres to various surfaces exposed to wide temperature fluctuations.

   Contractor: J. B. Schutt for GSFC (GSFC-366) B65-10156

3. **Special Coatings Control Temperature of Structures**

   Special coatings in the form of paints that exhibit controlled ratios of sunlight absorptivity to grey-body emissivity control the temperature of structures in space flight. These finishes exhibit good resistance to ultraviolet radiation and do not discolor.

   Contractor: Ball Brothers Research Corporation for GSFC (GSFC-444) B65-10337

4. **Structural Thermal-Control Coatings**

   Specifications have been formulated for application of thermal-control paints on large radar antenna structures exposed to solar radiation. The paint minimizes thermally induced mechanical deflections and glare of incident solar radiation.

   Contractor: Stoller for NPO (NPO-10785) B68-10553

5. Flexible Protective Coatings Made From Silicon-Nitrogen Materials

Contractor: Southern Research Institute for MFSC (M-FS-528) B66-10027

Flexible protective coatings formed from either of two polymers endure high temperatures for long periods. One polymer is a byproduct in hexaphenylcyclotrisilazane preparation, the other is obtained by heating bis/methylamino/diphenylsilane.

6. Development of Space-Stable Thermal-Control Coatings

Contractor: IIT Research Institute (NAS8-5379) N69-29596

Potassium silicate and sodium acid phosphate encapsulation reduced zinc orthotitanate degradation during ultraviolet vacuum irradiation. Pigmentation in potassium silicate was most effective in preventing the formation of the broad, bleachable absorption band centered at about 800-mm wavelength that characterizes untreated zinc orthotitanate. Electromagnetic resonance spectra of trapped charges in zinc oxide powder seemed to indicate a very low symmetry. Silicate treatment of zinc oxide prevented the formation of magnetic centers by irradiation.

ELECTRICAL

1. Single Connector Provides Safety Fuses for Multiple Lines

Contractor: McDonnell Aircraft for MSC (MSC-199) B66-10050

Fuse-bearing sleeve which is inserted between the male and female members of a multiple-line connector contains a safety fuse for each pin of the connector assembly. The sleeve is easily and quickly opened for fuse replacement.

2. Refractory-Metal Compound Impregnation of Polytetrafluoroethylene

Process impregnates polytetrafluoroethylene/PTFE/ with rhenium or molybdenum compounds. The PTFE thus impregnated combines chemical inertness with greater electrical conductivity than untreated PTFE. They are useful for electrochemical cells, chemical processing equipment, catalysts, electrostatic charge removal, RF gasketing, and cable shielding.

Contractor: H. F. Leibecki for Lewis (Lewis-10733) B69-10072

3. Inexpensive Electrical Connector is Moisture and Corrosionproof

Compression-sealed electrical connector made principally of plastic components is used in a corrosive atmosphere. This inexpensive and moistureproof connector can be modified to provide a multiple-pin connector.

Contractor: North American Aviation for MSC (MSC-164) B65-10196

4. Solid-State Recoverable Fuse Functions as Circuit Breaker

Molded, conductive-epoxy recoverable fuse protects electronic circuits during overload conditions, and then permits them to continue to function immediately after the overload condition is removed. It has low resistance at ambient temperature, and high resistance at an elevated temperature.

Contractor: E. F. Thomas, Jr. for GSFC (GSFC-560) B66-10691

5. Plastic Molds Reduce Cost of Encapsulating Electric Cable Connectors

Resin casting of the aluminum master pattern forms a plastic mold for encapsulating a cable connector. An elastomer is injected into the mold and cured.

Contractor: D. Knott for MFS (MFS-69) B63-10568

The mold is disassembled leaving an elastomeric encapsulation around the connector.

6. Multichannel Wireway Adapter Box

   Adapter box provides continuous separation of different electrical leads at points where their runs must intersect. Thus, multichannel conduits of standard commercial design may be used in a manner that prevents crossing of wire leads carrying different currents where the runs intersect and change direction.

   Contractor: North American Aviation for MSC (MSC-90645)
   B68-10052

7. Flat Conductor Cable

   Flat conductor cable can be used in electrical distribution systems where weight, space, cost reduction, lead time, reliability, and uniform electrical characteristic are of prime importance. Flat conductor cable is made of rolled flat conductors laminated between thin flexible plastic insulating films.

   Contractor: Marshall Space Flight Center (NASA SP-5043)
   NASA SP-5924(01)

FIRE AND SECURITY CONTROL

1. Fire Retardant Foams Developed to Suppress Fuel Fires

   Heat insulating polyurethane foam retards and suppresses fuel fires. Uniformly dispersed in the foam is a halogenated polymer capable of splitting off hydrogen halide upon heating and charring of the polyurethane.

   Contractor: R. Fish, W. J. Gilwee, J. A. Parker, S. R. Riccitiello (ARC-10098)
   B68-10358

2. Prevention and Extinguishment of Fires Involving Hypergolic Propellants

   The likely effectiveness of a proposed Halon 1301 system for inerting the atmosphere of the spacecraft LM adapter was investigated, as to the extent of protection afforded by Halon

   Contractor: Bureau of Mines (NASA Order-CC-59100)
   N69-27184

1301 alone against Aerozine-50 spills and fires, and as to the ways in which water or CO_2 could be used along with it for improved protection. The results of ten study tasks are reported. It is concluded that: (1) the propellant Aerozine-50 poses severe fire and explosion hazards unless unusual measures are taken for inerting and for fire extinguishment; (2) water is the only agent effective in all aspects of inerting and extinguishment studied; (3) Halon 1301 provides a valuable possibility of preventing A-50 fires by inerting but cannot be depended upon to extinguish an A-50 fire because of the high concentrations that would be required; (4) no useful inerting or extinguishment technique is found based on either the mildly exothermic reaction of CO_2 with A-50 or on the endothermic replacement reactions of ammonium salts with A-50.

3. Evaluation of High Expansion Foam For Spacecraft Fire Extinguishment

   Contractor: E. W. Bliss Company Research And Development Division (NAS9-7983) N69-20776

   The problem was to demonstrate the feasibility of using high expansion foam to extinguish a model fire of dry cellular fuel inside an oxygen rich enclosure at various spacecraft operating pressures. This problem was solved by assembling a 400 cubic foot hypo/hyperbaric fire test facility in which a 12 inch by 12 inch by 2 inch high opened celled formed polyurethane fuel specimen or a cotton twill laboratory smock fuel specimen could be burned in air; 95% Oxygen; 70% Oxygen-30% Helium; and 50% Oxygen-50% Nitrogen environments at 5, 10, 14.7 and 16.5 psia.

FOUNDATION MATERIAL

1. Thermoplastic Rubberlike Material Produced at Low Cost

   Contractor: F. J. Hendel (JPL-793)

B66-10453

Thermoplastic rubberlike material is prepared by blending a copolymer of ethylene and vinyl acetate with asphalt and a petroleum distillate. This low cost material is easily molded or extruded and is compatible with a variety of fillers.

2. Post-Stressed Concrete Foundation May Reduce Machinery Vibration

Contractor: S. H. Fistedis (ARG-130) B67-10237

Post-stressing concrete mat foundation reduces excessive vibrations in machinery. The mat is stressed in compression after the machinery is mounted, thus closing any cracks in it, altering the distribution of the soil subgrade reaction on the mat, and changing the mat- subgrade natural frequency.

HEATING/COOLING

1. Heater Control Circuit Provides Both Fast and Proportional Control

Contractor: R. W. Baslock (M-FS-906) B67-10097

Proportional control circuit supplies a heater with full current, from a pulsating dc source, to a present temperature and then switches to proportional control for fine temperature regulation. Two resistors and a diode are added to the existing circuit. The circuit can be adapted to control other function.

2. Thin Film Thermal Detector

Contractor: J. Maserjian (JPL-943) B67-10505

Abnormally large variation of capacitance with temperature is obtained in thin film capacitors when a fixed ionic space charge is present in sufficient density in a dielectric film. This effect is the basis for a new kind of thin film thermal detector, whose performance at room temperature equals or exceeds that of comparable devices at much lower temperatures.

3. Design of Fluid-Duct Bends With Low Pressure Loss

Duct bends are designed in which pressure losses and velocity profile distortions due to centrifugal force gradients are significantly reduced. The correction is achieved by properly changing the cross sectional area through the bend without affecting the shape of the duct at the upstream and downstream sides.

Contractor: Southwest Research Institute
(M-FS-20176)
B68-10395

4. A Design Procedure for the Weight Optimization of Straight Finned Radiators

Design technique evaluates optimum weight of space radiator consisting of finned, right circular cylinder.

Contractor: Battelle Memorial Institute
(GSFC-547)
B66-10618

INSULATION

1. Dispersion of Borax in Plastic is Excellent Fire-Retardant Heat Insulator

A mix of borax powder and a chlorinated anhydrous polyester resin yields a plastic composition that is fire-retardant, yields a minimum of toxic gases when heated, and exhibits high thermal insulating properties. This composition can be used as a coating or can be converted into laminated or cast shapes.

Contractor: H. Evans, J. Hughes, F. Schmitz
(ARG-5)
B67-10016

2. Organic Reactants Rapidly Produce Plastic Foam

Adding trichlorofluoromethane to polyether resin accelerates the reaction between the resin and toluene diisocyanate. This accelerated reaction instantaneously produces a plastic foam of low density and uniform porosity needed to provide buoyancy for flotation recovery of instrument packages dropped into the sea from spacecraft.

Contractor: G. F. Look
(See also B65-10090)
(Langley-37)
B65-10288

3. Storage-Stable Foamable Polyurethane is Activated by Heat

Polyurethane foamable mixture remains inert in storage unit activated to produce a rapid foaming reaction. The storage-stable foamable composition is spread as a paste on the surface of an expandable structure and, when heated, yields a rigid open-cell polyurethane foam that is self-bondable to the substrate.

Contractor: Goodyear Aerospace Corporation
(Langley-187)
B66-10111

4. Newly Developed Foam Ceramic Body Shows Promise as Thermal Insulation Material at 3000° F

Optimized zirconia foam ceramic body shows promise as insulating media: displays low density and thermal conductivity, good thermal shock resistance, high melting point, and mechanical strength.

Contractor: United Aircraft Corporation
(M-FS-11968)
B67-10441

5. Improved Thermal Insulation Materials Made of Foamed Refractory Oxides

Foamed refractory oxides provide lightweight, reflective thermal insulation materials. The materials have a low bulk density and high thermal shock resistance.

Contractor: IIT Research Institute
(M-FS-735)
B66-10288

6. Aluminized Fiber Glass Insulation Conforms to Curved Surfaces

Layers of fiber glass with outer reflective films of vacuum-deposited aluminum or other reflective metal, provide thermal insulation which conforms to curved surfaces. This insulation has good potential for cryogenic systems.

Contractor: North American Aviation
(M-FS-477)
B66-10024

7. Blown Fluorocarbon Foam

The foaming technique that is more commonly used is fluo-

Marshall Space Flight Center

rocarbon blowing; a fluorocarbon liquid, which will boil slightly above ambient temperature (usually about 75° F [24° C]), is added to the polyol side of the foam formulation. When the components are mixed, the curing reaction liberates heat which raises the temperature of the liquid mix above the boiling point of the fluorocarbon which then vaporizes to foam mixture. Most polyurethane foams of either the carbon dioxide-blown or fluorocarbon-blown type cure relatively quickly. The foaming occurs within 1 to 3 minutes after the components are mixed, and curing proceeds to a tack-free surface within 5 to 15 minutes. The fluorocarbon-blown foams have become much more common than the carbon dioxide-blown foams because the fluorocarbon system provides better control of the foaming reaction and foam structure and lower thermal conductivity results directly from the lower conductivity of fluorocarbon in the foam cells in comparison with carbon dioxide.

Depending on the chemical composition of the starting isocyanate and polyol, the physical properties of polyurethanes can vary from very soft and flexible cushioning materials to hard, rigid foams. Two basic types of polyols are used; polyesters and polyethers. Depending on the type of polyol, the resulting product may be called either a polyester foam or a polyether foam.

Polyurethane, in general, and some of the semirigid formulations, in particular, have very good properties at cryogenic temperatures with a minimum tendency to become brittle.

8. Polyurethane Foam

Marshall Space Flight Center

Polyurethane foam has a myriad of applications including insulation, structural material, fireproofing, and finishes. The cost of this material is high; however, as volume use of this foam increases, the cost reduction will be significant.

9. Thermal Insulation Systems: A Survey

Contractor: Dr. Peter E. Glaser
Arthur D. Little, Inc.
NASA SP-5027

This survey summarizes and makes readily accessible data on the performance of thermal insulations and systems combining such insulations, particularly for cryogenic applications. It also indicates opportunities for improvements.

PLUMBING

1. Valve Designed With Elastic Seat

Contractor: W. F. MacGlashan
(JPL-442)
B65-10040

Absolute valve closure is accomplished by a machined valve with an axially annular channel which changes the outlet passage into a thin tubular elastic seat member with a retainer backup ring. The elasticity of the seat provides tight conformity to ball irregularity.

2. Pipe Joints Reinforced in Place With Fitted Aluminum Sleeves

Contractor: I. Cortez, Jr.,
J. Siegfried,
O. Wobig
(MSC-11109)
B67-10271

Installation of an aluminum sleeve, using specially designed tools, reinforces solder-sealed ferrule joints in installed small-diameter aluminum tubing. Tubing joints reinforced by this method withstand considerable torsional, tensional, and vibrational stresses at moderately elevated temperatures.

3. Hand-Tightened, High-Pressure Seal

   To provide flared tubing and hose connections for high-pressure hand tightened cryogenic service, a 1/4 inch male AN seal was modified by machining to receive a special, double-truncated-cone-shaped Kel-F washer between it and the flared flex hose connector.

   Contractor: North American Rockwell Corp. (MFS-18416) B68-10417

4. Tube Joint Leak Repair Coupling

   Tube joint leak repair coupling consists of 2 split seals, 1 male split nut, 1 female split nut, and two aligning pins. Each split nut consists of 2 half-shell sections which, when engaged, are held together by a dovetail joint and an aligning pin.

   Contractor: North American Rockwell Corporation (MSC-15022) B68-10540

5. Diaphragm Eliminates Leakage in Cryogenic Fluid Duct Coupling

   Duct coupling with nickel steel diaphragm of low thermal expansivity is leakproof when used with cryogenic fluids. The diaphragm, located between the two flanges of the coupling, reduces axial shrinkage at the coupling flanges to a minimum.

   Contractor: Douglas Aircraft Company (WOO-142) B65-10227

STRUCTURAL MATERIAL AND CALCULATIONS

1. Materials Data Handbooks Prepared for Aluminum Alloys 2014, 2219, and 5456, and Stainless Steel Alloy 301

   Materials data handbooks summarize all presently known properties of commercially available structural aluminum alloys 2014, 2219, and 5456 and structural stainless steel alloy 301. The information includes physical and mechanical property data and design data presented in tables, illustrations, and text.

   Contractor: Syracuse University Research Institute (M-FS-1959; M-FS-1960; M-FS-1961; M-FS-1962) B67-10089

2. Fiberglass-Reinforced Structural Materials for Aerospace Application

Contractor: Boeing Company
(MFS-14806)
B68-10360

Evaluation of fiberglass-reinforced plastic materials concludes that fiberglass construction is lighter than aluminum alloy construction. Low thermal conductivity and strength makes the fiberglass material useful in cryogenic tank supports.

3. Heavy-Gage Bonded Honeycomb Sandwich as Primary Load-Bearing Structure

Contractor: General Dynamics
(M-FS-12060)
B67-10427

Heavy-gage bonded honeycomb sandwich is used as a primary load-bearing structural material in large-diameter booster. Theoretical investigations based on small deflection theory for prediction of stress fields and buckling loads, and structural testing were made. This structure is a potential weight saver for compression load-critical components.

4. Rigidizing Honeycomb With Paradichlorobenzene for Machining

Contractor: Marshall Space Flight Center
XMF-07725

Paradichlorobenzene is used as a filler and rigidizer to permit brazed or bonded steel honeycomb sandwiches to be machined or formed. Previously, conventional cutting methods often tore the core of the honeycomb and forming methods crushed it.

An undersized hole is cut in the face sheet of the honeycomb using a drill, bow saw, or end mill. The exposed core is filled with molten paradichlorobenzene (commonly found in "moth balls"). A hole of the desired size is then cut using a drill, reamer, bow saw, end mill, file, etc., refilling the exposed portions of the honeycomb core as necessary. When the hole is completed, the bulk of the remaining filler is removed by blowing with hot air

that is not over 250°F to melt the filler, and hot vacuuming. The residue will evaporate through sublimation at room temperature.

The filler is used to rigidize the core in the same way for roll forming or brake forming to prevent collapsing of the core.

5. Development of High Strength, Brazed Aluminum, Honeycomb Sandwich Composites Adaptable For Both Elevated and Cryogenic Temperature Applications, Volume 1: Brazing Alloy Development and Selection

Contractor: B. E. Kramer and D. Y. Potter (NAS8-5445) N67-25873

Commercially available brazing alloys, No. 716 and No. 719, were used to successfully braze X7005, X7106 and 7039 honeycomb core sandwich panels. New brazing alloys in the systems Al-Ge-Si-Zn and Al-Ge-Si-Ag, were developed and successfully joined X7106. Feasibility hardware have shown that node flow can be achieved and that node filleting plus the properties of the brazing alloy demonstrated improvements over comparable bonded structures. Brazed sandwich panels show improved resistance to delamination and predictable performance over a wide temperature spectrum. It was concluded that optimum brazing alloy wetting and flow required the brazing alloy to be clad onto the substrate metal. However, acceptable brazements were produced by using separately placed brazing alloy foil. The experimental results from quenching and heat treating studies showed that aluminum honeycomb sandwich panels can be quenched into liquid nitrogen with minimum distortion. Large flat and cylindrical section sandwich brazements were fabricated by that method. Consequently, high strength alloys with rapid quench rate requirements may be utilized for both core and facing materials.

6. Preformed Stiffeners Used to Fabricate Structural Components For Pressurized Tanks

Process of fabricating stiffened section components of pressurized tanks for aerospace use was developed. A potential use of the fabrication process is the production of gore and quarter-panel sections of hydrogen and oxygen tanks for space-vehicle boosters.

Contractor: North American Aviation
(M-FS-1796)
B66-10688

7. Fatigue of Reinforced Concrete Beams Under Dynamic Loading

Study, consisting of a literature survey and experiments, determined the strength properties of reinforced concrete beams subjected to vibrational stresses.

Contractor: Wylie Laboratorie
(M-FS- 14980)
B68-10515

8. Acid Spray Technique Mills Aluminum Alloy Materials Without Immersion

Acid spray machining technique chemically mills aluminum alloy panels without immersing them in an etchant. The spray does not require artificial heating to initiate the etching process.

Contractor: Lockheed Missile and Space Compar
(M-FS-12500)
B67-10463

SURFACE MATERIALS

1. Fiberglass Prevents Cracking of Polyurethane Foam Insulation on Cryogenic Vessels

Fiberglass material, placed between polyurethane foam insulation and the outer surfaces of cryogenic vessels, retains its resilience at cryogenic temperatures and provides an expansion layer between the metal surfaces and the polyurethane foam, preventing cracking of the latter.

Contractor: McDonnell Dougla Corporation
(M-FS-20058)
B68-10406

2. New Class of Thermosetting Plastics Has Improved Strength, Thermal and Chemical Stability

Contractor: TRW Systems
(Lewis-10108)
B67-10197

New class of thermosetting plastics has high hydrocarbon content, high stiffness, thermal stability, humidity resistance, and workability in the precured state. It is designated cyclized polydiene urethane, and is applicable as matrices to prepare chemically stable ablative materials for rocket nose cones of nozzles.

3. Variable-Transparency Wall Regulates Temperatures of Structures

Contractor: W. J. O'Sullivan Jr.
(Langley-25)
B63-10528

An effective temperature regulating wall consists of one layer /e.g., one of the paraffins/ relatively opaque to thermal radiation in the solid state and transparent to it in the molten state and placed between two transparent layers. A mirror coating is applied to back layer.

4. Improved Molding Process Ensures Plastic Parts of Higher Tensile Strength

Contractor: W. C. Heier
(Langley-10033)
B68-10132

Single molding process ensures that plastic parts/of a given mechanical design/ produced from a conventional thermosetting molding compound will have a maximum tensile strength. The process can also be used for other thermosetting compounds to produce parts with improved physical properties.

5. Refractory Ceramic Has Wide Usage, Low Fabrication Cost

Contractor: (MFS-67)
B63-10481

Particulate, fused amorphous silica is formed into complex shapes by casting in plaster molds. High temperature firing is not required. This ceramic is resistant

to thermal shock and exhibits good strength properties.

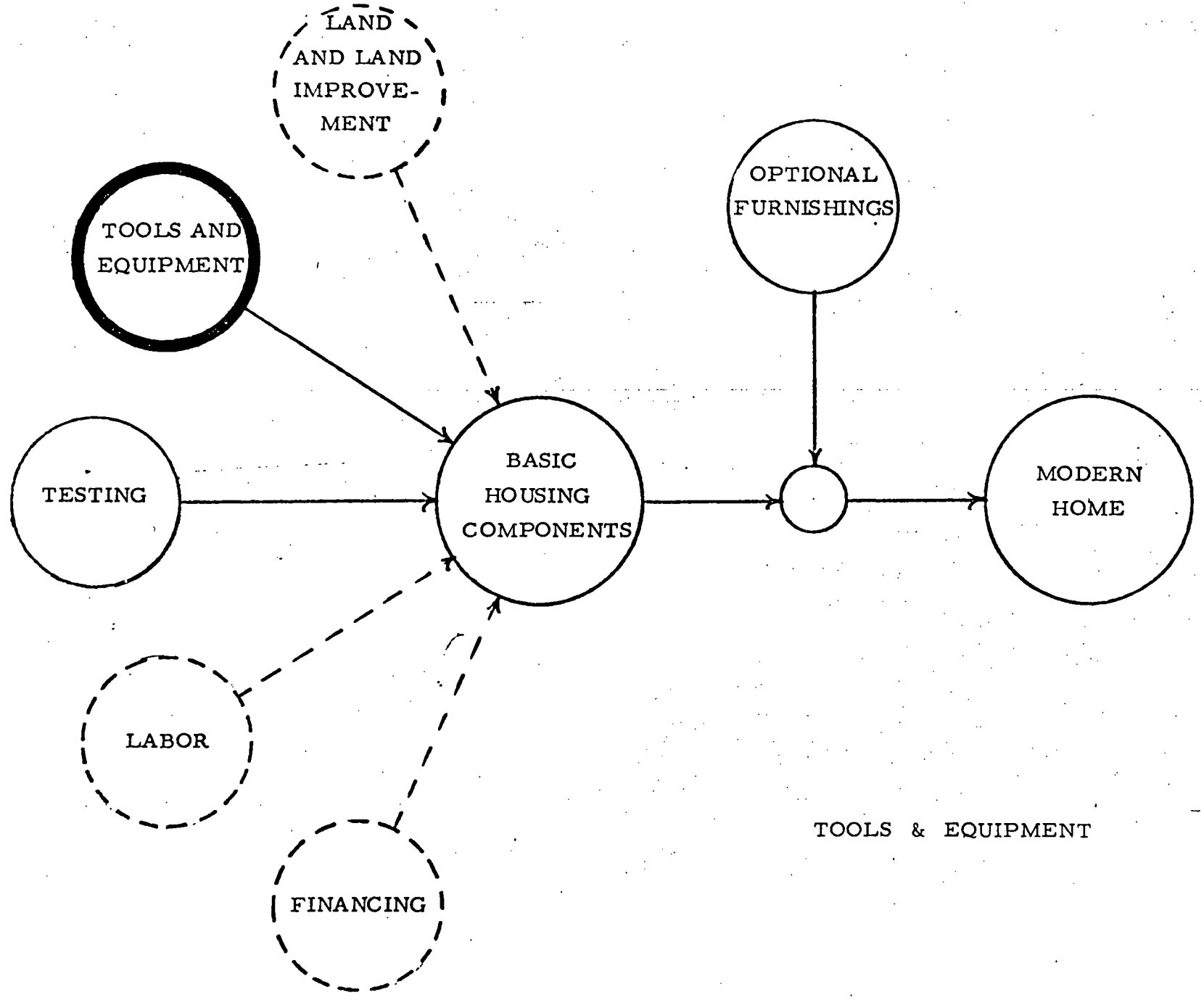
6. Composite Bulkhead Fabrication Development

   Composite bulkhead is produced by a fabrication concept utilizing vacuum and/or autoclave pressure to hold preformed welded sandwich elements in place during bonding and aging.

Contractor: J. Orr
(M-FS-1264)
B66-10582

3. TOOLS AND EQUIPMENT

TECHNOLOGY COMPONENTS OF A MODERN HOME



TOOLS & EQUIPMENT

TOOLS/EQUIPMENT

	Number of Products Discussed
Adhesives/Fasteners	7
Coatings /Finishes	2
Electrical:	
Communications	
Lighting	
Power	7
Fire & Security Control	
Foundation Material	
Heating/Cooling	1
Insulation	
Plumbing	12
Structural Material	4
Surface Material	6
General Category	8
TOTAL	47

TOOLS AND EQUIPMENT

ADHESIVES/FASTENERS

1. Hand Drill Adapter Accurately Limits the Depth of a Hole Bored With a Hand Drill

   Adapter can be made in appropriate sizes for bits of different diameter.

   Contractor: North American Aviation (MSFC-346) B66-10123

2. Gun to Facilitate Adhesive Bonding of Studs to Surfaces

   Used for mounting loads on walls where defacement with drilled holes cannot be tolerated.

   Contractor: W.G. Simpson & B.K. Davis (MSFC-20299) B69-10009

3. Torque Wrench

   Wrench used for tightening fasteners in restricted areas. Maximum output torque is 300 inch-pounds.

   Contractor: Lockheed Missile and Space Company (Lewis-246) B66-10011

4. Self-Locking Device for Fasteners

   A coiled spring device to ensure that screw threaded fastener remains secure.

   Contractor: North American Aviation (MSC-149) B65-10135

5. Impact Hand Tool

   Cartridge actuated impact hand tool to drive forced entry fasteners, punch holes, hammer and shear.

   Contractor: Olin Winchester-Western Division (MSFC-20140) B68-10371

6. Radiant Heat Source Bonding Oven

   Method to attach brackets to large structures.

   Contractor: North American Aviation (MSFC-11342) B67-10570

7. High-Torque Power Wrench, A Concept

   High-torque power wrench is small enough to be handled by one or two men yet has sufficient torque to remove 1-1/2 to 4-inch nuts from high-pressure tanks and valves. The action can be made automatic by use of solenoid-operated valves and suitable switches.

   Contractor: North American Rockwell Corp. (MSF-18194) B68-10299

COATINGS/FINISHES

1. Miniature Paint-Spray Gun

   Spray paint or other liquids onto surfaces at very close range without overspray to adjacent areas.

   Contractor: North American Rockwell Corp. (MSFC-13060) B68-10387

2. Spray Gun Modification

   When plastic resins and certain additives are mixed, premature hardening takes place in the tank of the gun causing clogging of the nozzle. This modification eliminates the problem.

   Contractor: Langley Research Center (Langley-6A) B63-10318

ELECTRICAL POWER

1. Tool to Heat and Apply Solder

   Used in close quarters, this tool heats and applies solder in one application.

   Contractor: Vernon Gudkese (Lewis-247) B66-10115

2. Coaxial Cable Stripper

   To provide a quick and accurate means of preparing coaxial cable for connector attachment in confined areas.

   Contractor. The Boeing Co. (KSC-10167) B68-10444

3. Tools for Flat Conductor Cable

   A list and description of tools, fixtures and test equipment for flat conductor cable.

   Contractor: Marshall Space Flight Center
   NASA SP-5924(01)

4. Apparatus for Processing Flat Conductor Cable

   Precision spacing of flat cable before conductors are laminated.

   Contractor: G. T. Schjeldahl Company
   (MSFC-20127)

5. Electrical Probe

   Probe used to ensure a reliable contact when it is inserted in a mating socket.

   Contractor: IBM
   (MSFC-315)
   B65-10215

6. Wire Puller

   Spring loaded beaded cable used to pull wire through formed lengths of pipe, tube, or conduit involving bends and elbows.

   Contractor: North American Aviation for Western Operations Office
   (WOO-108)
   B65-10031

7. Design Concept for Nonarcing Electrical Connector

   Connector plug automatically minimizes arcing during mating and demating. This plug uses a high-resistivity outer sheath as an extension to the regular pin contact. It is used in atmospheres containing explosive gases, and reduces erosion at the contact surfaces where mating and de-mating are performed frequently.

   Contractor: Douglas A/C
   (MSF-14937)
   B68-10404

HEATING/COOLING

1. Two Axis Winch

   Used to install heavy ducts in confined spaces.

   Contractor: North American Rockwell Corp.
   (MSFC-14254)
   B69-10062

PLUMBING

1. Aluminum Oxide Filler Prevents Obstructions in Tubing During Welding

   Granular aluminum oxide is used as filler in serpentine tubing while welding the tubing to a flat surface. The filler eliminates obstructions in the tubes formed by molten weld nuggets and is porous enough to allow gases to escape from the welding area.

   Contractor: K. P. O'Kelly
   (MSC-222)
   B66-10125

2. Tube Swaging Device Uses Explosive Force

   Tool joins a sleeve to a tube by explosive swaging, thus providing a leakproof, lightweight, and strong assembly. No new or different material is used in this method and therefore the thermal and galvanic properties are maintained.

   Contractor: D. G. McSmith
   (Langley-10092)
   B68-10235

3. Metal Tube Reducer is Inexpensive and Simple to Operate

   Low-cost metal tube reducer accepts tubing up to 1-inch outer diameter and can reduce this diameter to less than 1/2-inch with controlled wall thickness. This device can reduce all of the tube without waste. It produces extremely good surface finishes.

   Contractor: R. M. Mayfield
   (ARG-49)
   B67-10401

4. Electron Beam Selectively Seals Porous Metal Filters

   Electron beam welding selectively seals the outer surfaces of porous metal filters and impedances used in fluid flow systems. The outer surface can be sealed by melting a thin outer layer of the porous material with an electron beam so that the melted material fills all surface pores.

   Contractor: Hughes Aircraft
   for NASA - Lewis R. C.
   (LEW-10162)
   B68-10331

5. Heat-Shrink Plastic Tubing Seals Joints in Glass Tubing

Contractor: B. Del Duca (Lewis-10329) B68-10040

Small units of standard glass apparatus held together by short lengths of transparent heat-shrinkable polyolefin tubing. The tubing is shrunk over glass O-ring type connectors having O-rings but no lubricant.

6. Evaluation of Methods for Non-Destructive Testing of Brazed Joints

Contractor: A. Kanno (ARG-90175) B68-10191

Evaluation of nondestructive methods of testing brazed joints reveals that ultrasonic testing is effective in the detection of non-bonds in diffusion bonded samples. Radiography provides excellent resolutions of void or inclusion defects, and the neutron radiographic technique shows particular advantage for brazing materials containing cadmium.

7. Reinforced Thermal-Shock Resistant Ceramics

Contractor: Thompson Ramo Wooldridge (Lewis-10376)

Composite material, made by dispersing short tungsten-rhenium fibers randomly throughout zirconium oxide, is highly resistant to oxidizing environments at temperatures above 2000 degrees F. This reinforced ceramic is also thermal stress resistant.

8. Bench Vise Adapter Grips Tubing Securely and Safely

Contractor: North American Aviation (MSC-279) B66-10056

Plastic self-compressing adapter with grooves, attached to the jaws of a bench vise, secures thin-wall tubing vertically or horizontally during cutting and flaring operations without marring or damaging it. Magnets incorporated in both sections of the adapter prevent detachment from the jaws when the vise is opened.

9. Diaphragm Eliminates Leakage in Cryogenic Fluid Duct Coupling

Duct coupling with nickel steel diaphragm of low thermal expansivity is leakproof when used with cryogenic fluids. The diaphragm, located between the two flanges of the coupling, reduces axial shrinkage at the coupling flanges to a minimum.

Contractor: Douglas Aircraft (WOO-142) B65-10227

10. Pipe Cutting Tool is Useful in Limited Space

Portable pipe cutting tool is used in areas of limited space. The pipe is clamped in the tool and then cut by a rotating cutter assembly that is internally connected to a drive shaft engaged in the chuck of a portable electric drill. The tool is held in a fixed position during the cutting operation.

Contractor: McDonnell A/C (MSC-36) B66-10102

11. Weld Preparation Tool for Pipes and Tubing

Improved scarfing tool consists of a mount-table, roller-guided assembly. It converts a conventional routing machine for relatively precise field preparation of pipes for welding.

Contractor: E. D. Wallace (KSC-09955) B68-10551

12. Method for Reinforcing Tubing Joints

Joint repair technique uses a longitudinally split aluminum shield over the joint ferrule and immediately adjacent tubing to reseal or reinforce leaking or weak joints in small tubing. Epoxy resin coating on inside surfaces of the two shield halves provides a tightly sealed bond between shield and tubing.

Contractor: J. Kinzler (MSC-11108) B68-10115

STRUCTURAL MATERIALS AND CALCULATIONS

1. **Computer Program Simplifies Selection of Structural Steel Columns**

   Contractor: G. S. Vissing (NUC-44) B66-10097

   Computer program rapidly selects appropriate size steel columns and base plates for construction of multi-story structures. The program produces a printed record containing the size of a section required at a particular elevation, the stress produced by the loads, and the allowable stresses for that section.

2. **Computer Program Performs Stiffness Matrix Structural Analysis**

   Contractor: R. Bamford (NPO-10502) B68-10096

   Computer program generates the stiffness matrix for a particular type of structure from geometrical data, and performs static and normal mode analyses. It requires the structure to be modeled as a stable framework of uniform, weightless members, and joints at which loads are applied and weights are lumped.

3. **Ultrasonic Quality Inspection of Bonded Honeycomb Assemblies is Automated**

   Contractor: North American Aviation (MSC-859) B66-10544

   Inspection system for bonded honeycomb assemblies is accurate, fast, and automated. The ultrasonic system consists of inner and outer transducer positioning assemblies with suitable motor controls, a centerless turntable assembly, water squirter assemblies, and an inspection program completely encoded on tape suitable for use on a high speed computer.

4. Improved Torch Increased Weld Quality in Refractory Metals

   Specially designed torch welds refractory metals in a vacuum purged, inert gas backfilled welding chamber/weld box/ with practically zero contamination resulting from its use. Included in the torch design is a radiation shield to protect the operators hands when welding at high amperages.

   Contractor: Westinghouse (LEW-324) B68-10041

SURFACE MATERIAL

1. Portable Display Paneling Has Wide Use, Easy Take Down and Assembly

   Design for a modular display panel is based on a cross-shaped corner connector and wooden lattice bars. The bars are fitted into the arms of the metal connector and a pocket slot holds a modular-size panel.

   Contractor: H. J. DeVoto (ARC-17) B63-10435

2. Portable Flooring Protects Finished Surfaces, is Easily Moved

   To protect curved, finished surface and provide support for workmen, portable flooring has been made from rigid plastic foam blocks, faced with aluminum strips. Held together by nylon webbing, the flooring can be rolled up for easy carrying.

   Contractor: R. J. Carmody (MFS-15) B63-10387

3. Composite Bulkhead Fabrication Development

   Composite bulkhead is produced by a fabrication concept utilizing vacuum and/or autoclave pressure to hold preformed welded sandwich elements in place during bonding and aging.

   Contractor: J. Orr (MFS-1264) B66-10582

4. Inflatable Bladder to Facilitate Handling of Heavy Objects, A Concept

   Inflatable bladder facilitates the removal of heavy, highly finished metal parts from tote boxes or shipping containers. The proposed concept permits removal without danger of damage to the parts or injury to handling personnel.

   Contractor: North American Rockwell Corp. (MFS-14272) B69-10069

5. Acid Spray Technique Mills Aluminum Alloy Materials Without Immersion

   Acid spray machining technique chemically mills aluminum alloy panels without immersing them in an etchant. The spray does not require artificial heating to initiate the etching process.

   Contractor: Lockheed Missiles & Space Co. (MFS-12500) B67-10463

6. Simulated Hailstone Fabrication and Use in Testing Weatherability of Structures

   Equipment fabricates and uses simulated hailstones to test the weatherability of exposed structures. The equipment projects the hailstones at velocities experienced in hailstorms.

   Contractor: F.W. Stoller (NPO-10783) B68-10552

GENERAL CATEGORY

1. Hoisting Frame Facilitates Handling of Large Objects

   Hoisting frame can be used with a standard 5-ton forklift to handle the large spreader bars, or other bulky pieces of equipment, much faster and more efficiently than with a boom or gantry crane. In addition, forklifts of this type are more readily available.

   Contractor: North American Rockwell Corp. (MFS-16166) B68-10575

2. Photographic and Drafting Techniques Simplify Method of Producing Engineering Drawings

Contractor: North American Aviation (MSC-716) B68-10128

Combination of photographic and drafting techniques has been developed to simplify the preparation of three-dimensional and dimetric engineering drawings. Conventional photographs can be converted to line drawings by making copy negatives on high contrast film.

3. Modified Soldering Iron Speeds Cutting of Synthetic Materials

Contractor: North American Aviation (MFS-725) B66-10246

Modified soldering iron cuts large lots of synthetic materials economically without leaving frayed or jagged edges. The soldering iron is modified by machining an axial slot in its heating element tip and mounting a cutting disk in it. An alternate design has an axially threaded bore in the tip to permit the use of various shapes of cutting blades.

4. Special Tool Kit Aids Heavily Garmented Workers

Contractor: Martin-Marietta Corp. (MSC-163) B66-10403

Triangular aluminum tool kit, filled with polyurethane is constructed to receive various tools and hold them in a snug but quick-release fit as an aid to heavily gloved workers. The kit is designed to allow mounting within easily accessable reach and to provide protection of the tools during storage.

5. Portable Sandblaster Cleans Small Areas

Portable sandblasting unit rapidly and effectively cleans localized areas on a metal surface. The unit incorporates a bellows enclosure, masking plate, sand container, and used sand accummulator connected to a vacuum system. The bellows is equipped with an inspection window and light for observation of the sanding operation.

Contractor: North American Aviation
(MSC-523)
B66-10242

6. Extendible Column Can Be Stowed on Drum

Column formed from a series of segments held together by an internal spring or cable can be coiled on a drum or extended into a rigid structure. This storable coil is useful in boring for soil samples and supporting electrical and optical sensors.

Contractor: G. M. Holtz
(JPL-686)
B65-10191

7. Collapsible Truss Structure is Automatically Expandable

Coil springs wound with maximum initial tension in a three-truss, closed loop structure form a collapsible truss structure. The truss automatically expands and provides excellent rigidity and close dimensional tolerance when expanded.

Contractor: General Electric
(GSFC-265)
B65-10126

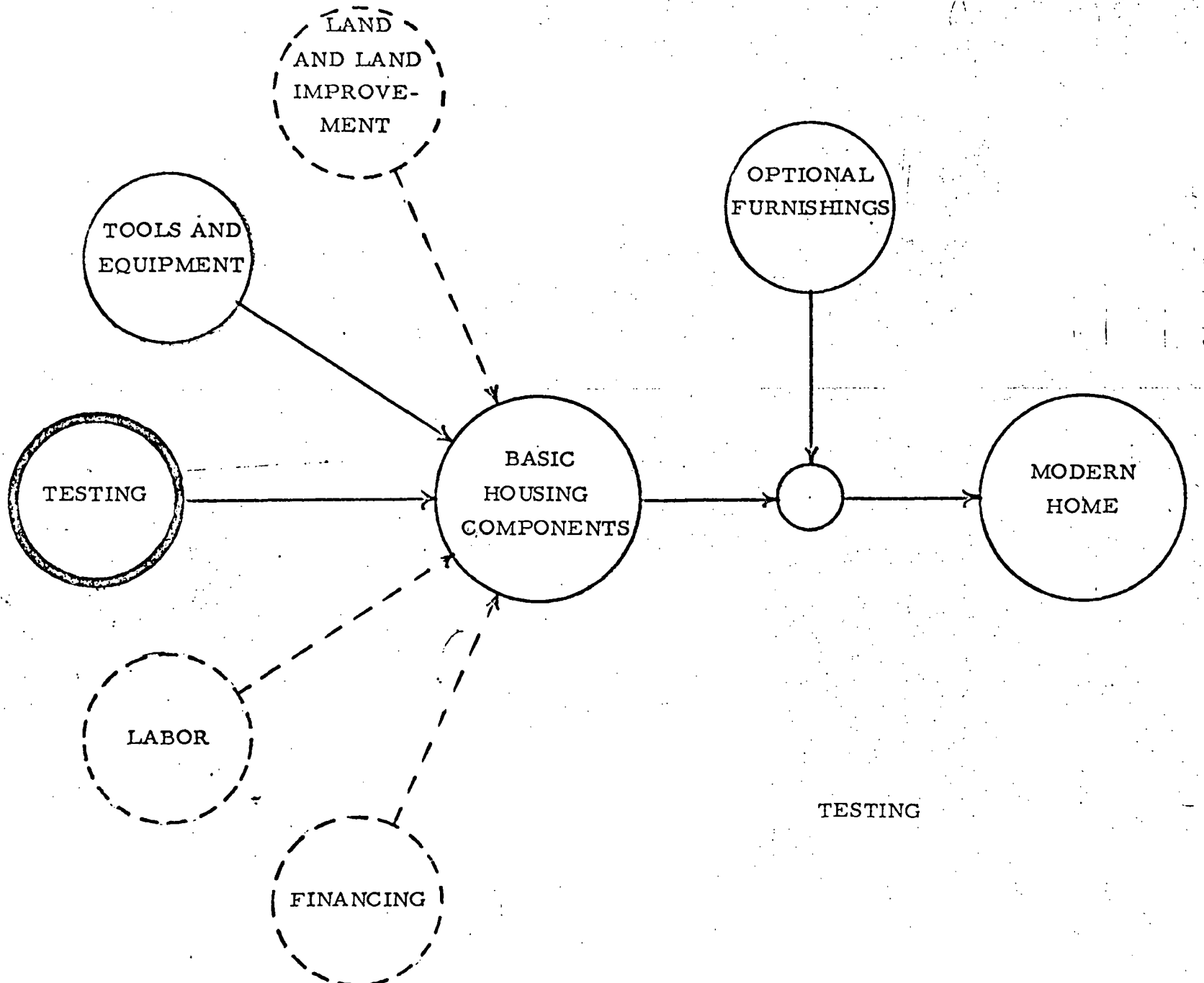
8. Buckle Joins Web Straps Quickly, Adjusts Easily

To join web straps used to hoist heavy loads, a novel buckle permits two straps to be quickly joined and held by the combined forces of strap load tension and friction.

Contractor: Chance Vought Corp.
(Langley-21)
B64-10119

4. TESTING

TECHNOLOGY COMPONENTS OF A MODERN HOME



TESTING

	Number of Products Discussed
Adhesives/Fasteners	2
Coatings /Finishes	1
Electrical:	
Communications	
Lighting	
Power	
Fire & Security Control	1
Foundation Material	
Heating/Cooling	2
Insulation	1
Plumbing	4
Structural Material	7
Surface Material	2
General Category	4
TOTAL	24

TESTING

ADHESIVES/FASTENERS

1. Cure of Epoxy Resins Determined By Simple Tests

   Rapid visual and simple quantitative tests indicate the degree of cure of particular epoxy resin binders in prepreg stock. It is possible that these tests may be extended to a number of different epoxy formulations.

   Contractor: North American Aviation
   (MFS-13131 & 13132)
   B68-10043

2. Ultrasonic Emission Method Enables Testing of Adhesive Bonds

   Detection of acoustic energy emitted by adhesive bonds subjected to tensile stresses at frequencies above sixteen kilocycles per second is used as a method for determining strength. This method is used in measuring adhesive bond strengths on metal honeycomb core panels.

   Contractor: General American Transportation
   (M-FS-799)
   B66-10341

COATINGS AND FINISHES

1. Experiments with Ceramic Coatings

   Report describes the procedures and techniques used in the application of a ceramic coating and the evaluation of test parts through observation of the cracks that occur in this coating due to loading.

   Contractor: North American Rockwell Corporation
   (M-FS-18150)
   B68-10355

FIRE AND SECURITY CONTROL

1. Technique for Assessing Potential Fire Hazards

   Contractor: General Electric for NASA
   (HQN-10279)
   B69-10287

Combustion hazard modeling technique developed which may prove a valuable aid in assessing potential fire hazards in spacecraft ignition areas. The analytical techniques and procedures could also be used as a basis for meaningful prediction of ignition and fire propagation hazards. This technique limits the fire evaluation to a description of only thermal energy exchanges which are involved in the burning process.

HEATING AND COOLING

1. New Computer Program Solves Wide Variety of Heat Flow Problems

   Contractor: Boeing Company (M-FS-421) B66-10404

   Boeing Engineering Thermal Analyzer /BETA/ computer program uses numerical methods to provide accurate heat transfer solutions to a wide variety of heat flow problems. The program solves steady-state and transient problems in almost any situation that can be represented by a resistance-capacitance network.

2. Cleanroom Air Sampler Counts, Categorizes, and Records Particle Data

   Contractor: IIT Research Institute (M-FS-2221) B67-10076

   Light scattering particle counter monitors particles in a clean room. It categorizes and records the particles according to size and functions simultaneously in three separate areas. The counter uses a transducer head to transform light signals into electric signals.

INSULATION

1. Method of Measuring Thermal Conductivity of High Performance Insulation

   Contractor: Lockheed Missiles and Space Company (M-FS-14088) B68-10013

Method accurately measures the thermal conductivity of high-performance sheet insulation as a discrete function of temperature. It permits measurements to be made at temperature drops of approximately 10 degrees F across the insulation and ensures measurement accuracy by minimizing longitudinal heat losses in the system.

PLUMBING

1. Automatic, Nondestructive Test Monitors In-Process Weld Quality

   Instrument automatically and non-destructively monitors the quality of welds produced in microresistance welding. It measures the infrared energy generated in the weld as the weld is made and compares this energy with maximum and minimum limits of infrared energy values previously correlated with acceptable weld-strength tolerance.

   Contractor: Martin-Marietta Corp. (M-FS-14996) B68-10333

2. Closed Circuit TV System Monitors Welding Operations

   TV camera system that has a special vidicon tube with a gradient density filter is used in remote monitoring of TIG welding of stainless steel. The welding operations involve complex assembly welding tools and skates in areas of limited accessibility.

   Contractor: North American Aviation (MSC-11002) B67-10162

3. Ultrasonic Hand Tool Allows Convenient Scanning of Spot Welds

   Small, portable, electrically powered hand tool, coupled with auxiliary ultrasonic equipment, allows convenient scanning of spot welds for discontinuities.

   Contractor: Boeing Company (M-FS-539) B66-10289

4. Ultrasonic Recording Scanner Used For Nondestructive Weld Inspection

Contractor: Boeing Company
(M-FS-284)
B66-10220

Portable ultrasonic recording scanner is used for non-destructive inspection of welds. It is adaptable to continuous operation in one direction while maintaining oscillatory motion at a right angle to this direction. The scanning speed and oscillation frequency are independently adjustable.

STRUCTURAL MATERIALS

1. Ultrasonics Used to Measure Residual Stress

Contractor: R. W. Benson and Associates
(M-FS-12449)
B67-10428

Ultrasonic method is used to measure residual stress in metal structures. By using this method, various forms of wave propagation in metals are possible, and more thorough analysis of complex geometric structures may be had.

2. Detection of Entrapped Moisture In Honeycomb Sandwich Structures

Contractor: North American Aviation
(MSC-1103)
B67-10116

Thermal neutron moisture detection system detects entrapped moisture in intercellular areas of bonded honeycomb sandwich structures. A radium/beryllium fast neutron source bombards a specimen. The emitted thermal neutrons from the target nucleus are detected and counted by a boron trifluoride thermal neutron detector.

3. Nondestructive Testing Techniques Used In Analysis of Honeycomb Structure Bond Strength

Contractor: North American Aviation
(M-FS-1214;M-FS-1221)
B67-10574

DOT/Driver-Displacement Oriented Transducer/, applicable to both lap shear type application and honeycomb sandwich structures, measures the displacement

of the honeycomb composite face sheet. It incorporates an electromagnetic driver and a displacement measuring system into a single unit to provide non-contact bond strength measurements.

4. Surface-Crack Detection by Microwave Methods

   Microwave surface-crack detection system examines metallic surfaces with a noncontacting probe. The change in the microwave signal reflected from the surface under investigation is an indication of the existence of surface flaws. This technique can detect flaws and scratches as small as 100 microinches.

   Contractor: L. Feinstein, R. Hruby (ARC-10009) B67-10482

5. New Camera Tube Improves Ultrasonic Inspection System

   Electron multiplier, incorporated into the camera tube of an ultrasonic imaging system, improves resolution, effectively shields low level circuits, and provides a high level signal input to the television camera. It is effective for inspection of metallic materials for bonds, voids, and homogeneity.

   Contractor: Northwestern University (ARG-90237) B68-10088

6. Development Of Mechanized Ultrasonic Scanning System

   Mechanized ultrasonic scanning system inspects the flaw content in the welds of space vehicle booster stages and propellant tanks. It is capable of scanning welds at speeds greater than 1 inch per second.

   Contractor: R. Evans, J. A. MacDonald (M-FS-13638) B68-10004

7. NASA Composite Bulkhead Development Program

   Contractor: W. Gore (NAS8-11874) N66-23743

Results are reported in a program to establish the feasibility of manufacturing an adhesive bonded honeycomb sandwich bulkhead utilizing a bond cycle which would cure the adhesive, age the face sheet weldments, and size them to their exact contours. The program included detail design of the finished article, development of the cure cycle, tool design and fabrication, construction, testing of the assembly and final evaluation and inspection. Testing included radiographic evaluation of weldments, adhesive bonding process control specimens, ultrasonic testing of the bond, and rigid dimensional recording at various stages of construction.

SURFACE MATERIAL

1. Liquid Crystals Detect Voids In Fiberglass Laminates

   Contractor: General Dynamics/ Convair (Lewis-10104) B67-10286

   Liquid crystal solution nondestructively detects voids or poor bond lines in fiberglass laminates. A thin coating of the solution is applied by spray or brush to the test article surface, and, when heated, indicates the exact location of defects by differences in color.

2. Polarized Light Reveals Stress In Machined Laminated Plastics

   Contractor: General Dynamics/ Convair (Lewis-10018) B67-10383

   Polarized light applied to drilled laminated plastic components exposes to the human eye the locked-in stresses that will result in fractures and delaminations when the soldering procedure takes place. This technique detects stresses early in the production cycle before

appreciable man-hours are invested in an item destined for rejection.

GENERAL CATEGORY

1. Calibrated Water Tank Facilitates Proof-Loading of Cranes And Derricks

   Calibrated steel water tank provides the weight loads required for proof-testing of cranes and derricks. The use of the water tank provides a safe, fast, economical method of proof-loading cranes and derricks.

   Contractor: Boeing Company
   (M-FS-15059)
   B69-10109

2. Handbooks for Non-Destructive Testing Using Ultrasonics

   Four handbooks have been prepared for use in teaching metal parts inspectors and quality assurance technicians the fundamentals of non-destructive testing using ultrasonic detection methods. The handbooks may be used in the shop or laboratory, or as study texts in technical schools and in the home.

   Contractor: General Dynamics
   Convair
   (M-FS-20409)
   B69-10108

3. Computer/PERT Technique Monitors Actual Versus Allocated Costs

   A computer method measures the user's performance in cost-type contracts utilizing the existing NASA program evaluation review technique without imposing any additional reporting requirements. Progress is measured by comparing actual costs with a value of work performed in a specific period.

   Contractor: J. D. Walker,
   E. Houry
   (Lewis-260)
   B67-10025

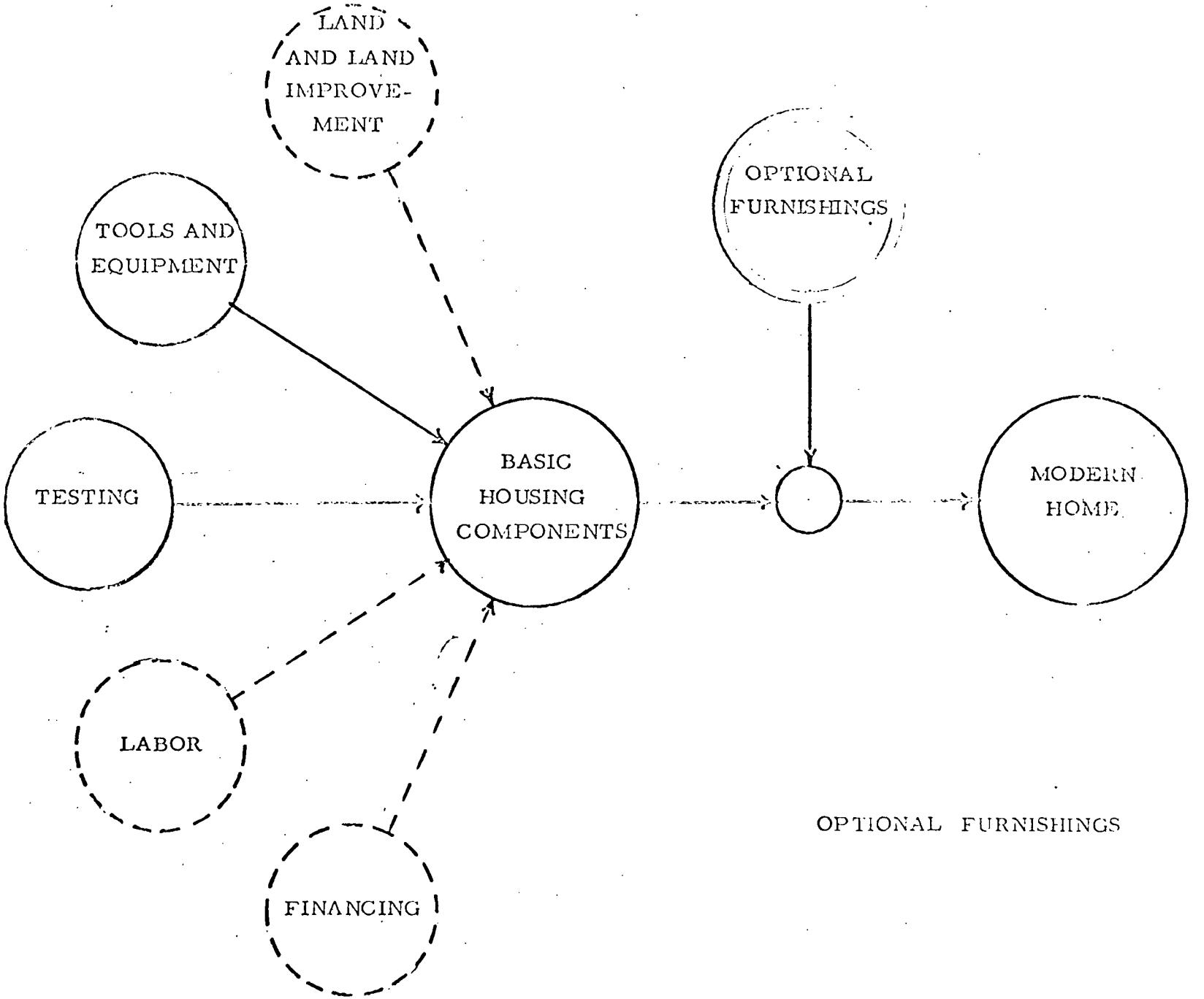
4. Graphic Visualization of Program Performance Aids Management Review

Chart technique /PERTREE/ which displays the essential status elements of a PERT system in a vertical flow array, of high graphic quality, enables visual review by management of program performance. Since the display is versatile, it can accommodate any aspect of the program which the presenter wishes to accent.

Contractor: Aerojet-General Corporation (NUC-10011) B67-10568

5. OPTIONAL FURNISHINGS

TECHNOLOGY COMPONENTS OF A MODERN HOME



OPTIONAL FURNISHINGS

OPTIONAL FURNISHINGS

	Number of Products Discussed
Adhesives/Fasteners	
Coatings/Finishes	9
Electrical	
Communications	
Lighting Power	
Power	3
Fire and Security Control	1
Foundation Material	1
Heating/Cooling	
Insulation	2
Plumbing	
Structural Material	
Surface Material	
General Category	
Fabrics	8
Furniture Material	3
Other	6
TOTAL	33

COATINGS/FINISHES

1. **Viton**

   Viton is a flame resistant material which along with fibers such as alumina or boron might be used as a composite structural material for furniture. It could also be sprayed onto a surface to form a scratch resistant, decorative finish.

   Source: NASA Manned Spacecraft Center
   Dale G. Sauers

2. **Inorganic Paint is Durable, Fireproof, Easy to Apply**

   Inorganic paint with a water-potassium silicate base is impervious to water. It is also fireproof and adheres to various surfaces exposed to wide temperature fluctuations. As demand increases for low maintenance, fire-proofed homes, this inorganic potassium silicate paint would potentially replace conventional interior paint.

   Source: J. B. Schutt for GSFC
   (GSFC-366)
   B65-10156

3. **Experiments With Ceramic Coatings**

   Report describes the procedures and techniques used in the application of a ceramic coating and the evaluation of test parts through observation of the cracks that occur in this coating due to loading.

   Source: North American Rockwell Corp.
   (M-FS-18150)
   B68-10355

4. **Aluminum Primer**

   White primer permits a corrosion-resistant coating base for aluminum. This primer can be brushed or sprayed onto a surface and affords excellent protection with a minimum film thickness.

   Source: Sherwin Williams Co. for Marshall Space Flight Center
   (M-FS-304)
   B66-10207

5. **High Temperature Polymers**

   Silazane polymers show promise as a high temperature material for use as adhesives, structural plastics, elastomers, coatings, and laminating resins.

   Source: Marshall Space Flight Center
   B66-10194

6. Coating Process

Source: Jet Propulsion Lab., Calif. Institute of Technology, Pasadena
Contract NAS7-100
(NASA-Case-XNP-6508)

The process permits application of a uniform coating of a synthetic resinous material to objects of irregular form without requiring that the objects be heated appreciably above ambient temperature. The method is suitable for coating circuit boards and similar objects which might be deteriorated or destroyed by elevated temperatures. The objects are coated essentially at room temperature with the resinous material, which is initially fluid at that temperature. The resinous material is frozen and comminuted at sub-ambient temperature, and as a cold powder melts on contact, forming a uniform coating which is subsequently cured substantially at ambient temperature to a hard solid.

7. Synthesis and Evaluation of New High Temperature Polymers For Coating Applications

Source: Midwest Research Institute, Kansas City, Missouri
Contract NAS8-11338
(NASA-CR-88757)

Experimental work is reported on the synthesis, characterization, and evaluation of organic and semiorganic polymers useful as coatings that will withstand high temperatures, high vacuum, and radiation. Polyphenylenesiloxanes, suitable for the preparation of films, were prepared by the condensation of arylenedisilanols with cyclic siloxazanes. The polymers, which represented a variety of structures and were characterized in detail, had high molecular weights and good high- and low-temperature properties. Several were screened under high vacuum-ultraviolet irradiation conditions. High molecular weight poly-benzoxazoles were prepared, but no satisfactory

method was found for preparing poly-benzoxazole films. Attempts to prepare titanium chelate polymers, titanoxanosiloxanes, and boroxanosiloxanes produced only low molecular weight products. An investigation of model systems for ferrocene polyesters and boron chelate polymers did not reveal any potentially useful methods of polymerization. Several other potentially useful polymer systems were examined briefly.

8. CNR

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

CNR is a flame-resistant, elastomeric material that could be used for decorative coatings on walls, panels and furniture.

9. Nomex

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

Nomex is a flame-resistant fibrous material from the nylon family which has a tensile strength of 5.5 G/Denier, a 17% elongation, a specific gravity of 1,38, and a service temperature of from -65°F to +500°F. It has excellent potential applications as a decorative material such as wall papering and upholstery covering.

ELECTRICAL

1. Personal Communication System Combines High Performance With Miniaturization

Contractor: North American Aviation
(MSC-722)
B67-10119

Personal communication system provides miniaturized components that incorporate high level signal characteristics plus noise rejection in both microphone and earphone circuitry. The microphone is designed to overcome such spacecraft flight problems as size, ambient noise level, and RF interference.

2. Ultraminiature Television Camera

Ultraminiature television camera with a total volume of 20.25 cubic inches, requires 28 vdc power, operates on UHF and accommodates standard 8-mm optics. It uses microelectric assembly packaging techniques and contains a magnetically deflected and electrostatically focused vidicon, automatic gain control circuit, power supply, and transmitter.

Contractor: Teledyne Systems Company
(M-FS-11967)
B67-10469

3. Panels Illuminated By Edge-Lighted Lens Technique

Electroluminescent lamps used to edge-light a specially ground lens provide nonglare, reduced eye strain panel illumination. There is no noticeable falloff in brightness along the lens edge. Light intensity diminished toward the lens center. A slight halo, observed along the lens edge, has no detrimental effect.

Contractor: North American Aviation
(MSC-871)
B66-10507

FIRE AND SECURITY CONTROL

1. Fire Extinguisher Control System Provides Reliable Cold Weather Operation

Fast acting, pneumatically and centrally controlled, fire extinguisher/Firex/system is effective in freezing climates. The easy-to-operate system provides a fail-dry function which is activated by an electrical power failure.

Contractor: North American Aviation
(M-FS-13031)
B67-10622

FOUNDATION MATERIAL

1. Thermally Conductive Metal Wool-Silicone Rubber Material can be Used as Shock and Vibration Damper

   Bronze wool pads, impregnated with silicone rubber, meet the requirement for a thermally conductive, shock and vibration absorbing material. They serve as spacers in equipment mounting and are resistant to high temperatures.

Contractor: W. W. Hough (JPL-321) B63-10207

INSULATION

1. Asbeston

   Asbeston is a fibrous flame barrier insulation material that has a tensile strength of 2.5 to 3.1 G/Denier, an elongation of 2 to 3%, a specific gravity of 2.1 to 2.8, and a service temperature use from -200°F to +2400°F It has potential uses in bedspreads, blankets, drapes and upholstery covering.

Source: NASA Manned Spacecraft Center Frederic S. Dawn

2. Dispersion of Borax in Plastic Is Excellent Fire-Retardant Heat Insulator

   A mix of borax powder and chlorinated anhydrous polyester resin yields a plastic composition that is fire-retardant, yields a minimum of toxic gases when heated, and exhibits high thermal insulating properties. This composition can be used as a coating or can be converted into laminated or cast shapes. As plastics become more popular as the basic material for furniture, borax has potential applications as a fire retardant additive.

Source: H. Evans, J. Hughes, F. Schmitz (ARG-5) B67-10016

GENERAL CATEGORY

FABRICS

1. **Beta**

   Beta is a flame-resistant, extremely fine glass fiber material which has a tensile strength of 15G/Denier, a 4% elongation, a specific gravity of 2.45, and a service temperature of from -300 to +900°F. It has potential commercial applications for use as a wall covering, upholstery covering, bedding, and protective work clothing.

   Source: NASA Manned Spacecraft Center
   Frederic S. Dawn

2. Textile Technology From Aerospace Research

   This paper presents a general review of government generated technology to illustrate their relevance to the textile and apparel industries. The applicable technology touched on a variety of areas concerned with fibers and fabrics; these include new products, thermal resistance, physical testing methods and manufacturing techniques. Many of these topics were not originally conceived as being applicable to commerical textile operations, but appear to have considerable potential for inter-industry transfer. An attempt has been made to select those items which may be of interest to textile management as well as to the technologist. These items should be viewed as samples of available relevant technology, not as an exhausted survey of the field. In addition, a bibliography is included to give a more comprehensive list of pertinent articles which are available from government publications.

   Source: IIT Research Institute
   Miles A. Greenbaum,
   W. J. Wheeler
   N68-36655

3. Fypro

Fypro is a fibrous, flame-resistant material. Fabric 5007/7 is not combustible in air, has an elongation of 24%, and a break-strength of 154 pounds/inch. Possible home furnishing applications include mattresses, sofa tickings, table cloths, upholstery, carpets, and rugs.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

4. Fluorel

Fluorel, a copolymer of hexafluoropropene and vinylidene fluoride is a flame-resistant elastomeric material which can be used in many forms. It has a tensile strength of 1500 to 2500 psi, and an elongation of of from 75 to 300% and a service temperature of from -40°F to +400°F.

A. In its solid form it could be used as a base material for furniture.
B. Applied to nylon, it could be used for non-flammable drapes, bedspreads, rugs, and tablecloths.
C. Applied to paper, it could be used for non-flammable wall paper and books.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

5. Durette

Durette is a very strong flame-resistant fibrous material. It has potential applications in almost any fabric usage as a thread.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

6. Polybenzimidazole (PBI)

PBI is a flame resistant, fibrous material which has a tensile strength of 4.5 G/Denier, an elongation of 12 to 13%, a specific gravity of 1.34 and a service temperature of from -65°F to 800°F. Because of its excellent fiber quality with the highest moisture regain of any known polymeric fiber, it has great potential use in clothing, drapes, spreads and upholstery covering.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

7. Teflon

Teflon is a fibrous, flame-resistant, abrasive-resistant material which has a tensile strength of 2.5 to 3.1 G/Denier, an elongation of 2 to 3%, a specific gravity of 2.1 and a service temperature of from -100°F to +500°F. Because of its abrasive characteristics, teflon potentially could be used for work coveralls, carpets, rugs, and upholstery coverings.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

8. In addition to the above citations, a study is available which discusses Optimal Cotton Blending and Yarn Production

Kansas State University
(NASA-CR-95849)
N68-86897

GENERAL

FURNITURE MATERIAL

1. Fluorinated Urethane

Fluorinated urethane is a flame-resistant, elastomeric material which can be formed to many design shapes. Because of this unique property, it could be applicable as a furniture material, for toys, and for decorative coatings.

Source: NASA Manned Spacecraft Center
Frederic S. Dawn

2. Carboxy Nitroso Rubber

Carboxy Nitroso Rubber is a flame-resistant elastomeric material which, along with a glass fiber reinforcement, could be used as a composite material to construct hard, scratch-resistant furniture.

Source: NASA Manned Spacecraft Center
Dale G. Sauers

3. Apollo Stowable Net Couch

The three-man stowable couch configurations, the functional design, and the stress analysis are summarized. The couch articulation, restraints, and suspension structure are briefly described along with the disassembly and stowage. The most critical structural areas in the system are considered to be the intersection of the Y-Y beam to the stabilizer beam and the couch hip joint. Actual mock-ups of the disassembly are reviewed, and the essentials of a development and qualification program are outlined. Drawings of the couch, and discussions of the loads, stress, and weight analyses and operating procedures are included.

Weber Aircraft Corp.
Contract NAS9-3497
(NASA-CR-65940; DR-5935)

GENERAL

OTHER

1. Illuminated Display Panel

Source: IBM for MSC
(MSC-108)
B65-10003

This illuminated display panel can be used for decorative purposes in a home. It is inexpensive, multi-colored, flexible, easily changed and readily fabricated at the point of use.

2. Apparatus of Small Size Can Be Extended Into Long, Rigid Boom

Contractor: J. V. Miller
(JPL-305)
B63-10200

Three metal sheets, having prenotched edges, are interlocked as they are unrolled from three feed rollers, which form a triangle. The apparatus is relatively small, and the sheets can be erected into a rigid triangular boom of considerable length.

3. New Inflatable Lifecraft is Non-Tippable

Contractor: G. A. Shewmake
(MSC-4A)
B64-10001

A one-seamed lightweight life raft has three underwater ballast buckets as stabilizers. Non-tippable, it can be compactly packaged and inflated with carbon dioxide.

4. Dispensing System Eliminates Torsion in Deployed Hoses

Contractor: IIT Research Institute
(MSC-80)
B65-10185

Dispensing system uses a rotating drum, transfer arm, and stationary drum to deploy, reel in, and store an attached hose. This system which eliminates torsion and minimizes strain and wear of flexible hoses, is used for handling flexible cables that have one end permanently attached to an outlet or connector.

5. Encapsulation Process Sterilizes And Preserves Surgical Instruments

Ethylene oxide is blended with an organic polymer to form a sterile material for encapsulating surgical instruments. The material does not bond to metal and can be easily removed when the instruments are needed.

Contractor: F.A. Morelli
(JPL-484)
B64-10066

6. Fiberglass Container Shells Form Contamination-Free Storage Units

Interchangeable molded fiberglass shells are locked together to form stroage units of various depths. These units can hold components weighing 1500 pounds, are easily transportable, and protect contents from contamination.

Contractor: North American Aviation
(WOO-275)
B66-10217